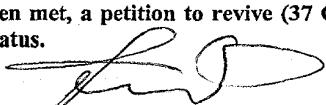


FORM PTO-1390 (REV. 9-2001)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER <b>35845/GM/1p</b>
<b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>				U.S. APPLICATION NO. (If known, see 37 CFR 1.5 <b>still 10/070749</b>
INTERNATIONAL APPLICATION NO. <b>PCT/EP00/08842</b>	INTERNATIONAL FILING DATE <b>4 SEPTEMBER 2000</b>	PRIORITY DATE CLAIMED <b>15 SEPTEMBER 1999</b>		
TITLE OF INVENTION <b>GAS-INSULATED SWITCHGEAR DEVICE</b>				
APPLICANT(S) FOR DO/EO/US <b>Costante PIAZZA - Libero SFONDRINI - Aldo SCIACCA</b>				
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:				
<p>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.</p> <p>4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <ul style="list-style-type: none"> <li>a. <input checked="" type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau).</li> <li>b. <input checked="" type="checkbox"/> has been communicated by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</li> </ul> <p>6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).</p> <ul style="list-style-type: none"> <li>a. <input type="checkbox"/> is attached hereto.</li> <li>b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).</li> </ul> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <ul style="list-style-type: none"> <li>a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).</li> <li>b. <input type="checkbox"/> have been communicated by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ul> <p>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).</p> <p>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p>				
Items 11 to 20 below concern document(s) or information included:				
<p>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment.</p> <p>14. <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.</p> <p>15. <input type="checkbox"/> A substitute specification.</p> <p>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.</p> <p>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</p> <p>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</p> <p>20. <input checked="" type="checkbox"/> Other items or information: <b>redrafted claims 15 to 28 for entering the preliminary amendment.</b></p>				

U.S. APPLICATION NO. (if known) See 37 CFR 1.5 still unknown	INTERNATIONAL APPLICATION NO. PCT/EP00/08842	ATTORNEY'S DOCKET NUMBER 35845/GM/1p		
21. <input checked="" type="checkbox"/> The following fees are submitted:		CALCULATIONS PTO USE ONLY		
<b>BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):</b>				
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO . . . . .		\$1040.00		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO . . . . .		\$890.00		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO . . . . .		\$740.00		
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) . . . . .		\$710.00		
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) . . . . .		\$100.00		
<b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b>		\$ 890.=		
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		\$		
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	\$
Total claims	14 - 20 =		x \$18.00	\$
Independent claims	1 - 3 =		x \$84.00	\$
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$280.00	\$
<b>TOTAL OF ABOVE CALCULATIONS =</b>		\$ 890.=		
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.		+ \$		
<b>SUBTOTAL =</b>		\$ 890.=		
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).		\$		
<b>TOTAL NATIONAL FEE =</b>		\$ 890.=		
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +		\$ 40.=		
<b>TOTAL FEES ENCLOSED =</b>		\$ 930.=		
		Amount to be refunded:	\$	
		charged:	\$	
a. <input type="checkbox"/> A check in the amount of \$ _____ to cover the above fees is enclosed.				
b. <input checked="" type="checkbox"/> Please charge my Deposit Account No. <u>13-3860</u> in the amount of \$ <u>930.=</u> to cover the above fees. A duplicate copy of this sheet is enclosed.				
c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>13-3860</u> . A duplicate copy of this sheet is enclosed.				
d. <input type="checkbox"/> Fees are to be charged to a credit card. <b>WARNING:</b> Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.				
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.				
SEND ALL CORRESPONDENCE TO:  <b>MODIANO &amp; ASSOCIATI</b> <b>Via Meravigli, 16</b> <b>20123 MILANO - ITALY</b> <b>EUROPE</b> <b>Tel.: 003902-85.90.77.77</b> <b>Milano, Italy - March 8, 2002</b>				
 SIGNATURE <b>Guido MODIANO</b> NAME <b>19,928</b> REGISTRATION NUMBER				

10/070749

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JC10 Rec'd PCT/PTO 11 MAR 2002

Docket No.35845/GM/lp

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Assignors : Costante PIAZZA - Libero SFONDRINI - Aldo SCIACCA  
Assignee : ABB SERVICE S.R.L.  
Ser. No. : still unknown  
Filed : still unknown  
For : "GAS-INSULATED SWITCHGEAR DEVICE"  
A.U. : still unknown  
Examiner : still unknown

Hon.

The Commissioner of Patents and Trademarks

**BOX P.C.T.**

Washington D.C. 20231 - U.S.A.

**PRELIMINARY AMENDMENT**

Sir,

please enter the following preliminary amendment in the above-identified Application:

substitute the original claims 1 to 14 with the enclosed redrafted claims 15 to 28.

It is to be noted that the newly submitted claims 15 to 28 do not

comprise any new matter but merely more clearly define Applicants' originally disclosed invention.

Respectfully submitted



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Tel.: +39-02-85907777

Milan, Italy – March 8, 2002

Encls.: a.a.

**WHAT IS CLAIMED IS:**

15. A gas-insulated switchgear device, having:

- a first bushing which accommodates a first terminal and a second bushing which accommodates a second terminal;
- 5 - a first enclosure which contains an interruption unit; and
- at least one first disconnection unit which has a first fixed contact which is electrically connected to said interruption unit, and a second fixed contact at ground voltage, and a first moving contact which is electrically connected to the first terminal and can be coupled to said first and second fixed contacts, said first moving contact being fixed to a rotary operating element and rotating rigidly therewith, the first and second fixed contacts lying on the rotation plane of said first moving contact, wherein said rotary operating element comprises a shaft made of insulating material, said shaft having an end which is connected to the first terminal and being suitable to support it structurally.
- 10
- 15

16. The switchgear device according to claim 15, wherein said first disconnection unit comprises an enclosure which has a substantially spheroidal central portion and two mutually opposite ends which are structurally connected respectively to said first enclosure and to said first bushing.

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17. The switchgear device according to claim 16, wherein said second fixed contact at ground voltage is arranged on the spheroidal portion.

18. The switchgear device according to claim 15, wherein the first moving contact is constituted by a blade which is keyed on said operating element and is substantially perpendicular to its rotation axis.

25

19. The switchgear device according to claim 15, wherein said first moving contact can be turned between a first position for coupling to the first fixed contact and a second position for coupling to the second fixed contact, the rotation angle between the first position and the second position being

between 30° and 150°, preferably between 60° and 120°, more preferably between 80° and 100°.

20. The switchgear device according to claim 15, comprising a second disconnection unit which is arranged inside said first enclosure and comprises

5 a third fixed contact which is connected to the second terminal and a fourth fixed contact which is at ground voltage, at least one second moving contact which can be coupled to at least one of said third and fourth fixed contacts and is electrically connected to said interruption unit, said second moving contact being fixed to a second rotary operating element and rotating rigidly therewith, the fixed contact that can be coupled to said second moving contact being arranged on the rotation plane of said second moving contact.

10 21. The switchgear device according to claim 20, wherein said second disconnection unit comprises a single moving contact and wherein said third and fourth fixed contacts lie on the rotation plane of the moving contact.

15 22. The switchgear device according to claim 20, wherein said second disconnection unit comprises a second moving contact and a third moving contact which are fixed to said second operating element, and wherein said third and fourth fixed contacts lie respectively on the rotation plane of said second and third moving contacts, which are fixed to said second operating element in a relative angular arrangement by virtue of which they cannot be simultaneously coupled respectively to said third and fourth fixed contacts.

20 23. The switchgear device according to claim 22, further comprising a third bushing which accommodates a third terminal and wherein said second disconnection unit comprises a fifth fixed contact which is connected to said

25 third terminal, a second moving contact and a third moving contact which are fixed to the second operating element, said third and fourth fixed contacts being arranged on the rotation plane of said second moving contact, the fifth fixed contact being arranged on the rotation plane of said third moving contact, the second and third moving contacts being fixed to the second operating element in a mutual angular arrangement by virtue of which they

30

cannot be simultaneously coupled respectively to said fourth and fifth fixed contacts.

24. The switchgear device according to claim 22, comprising a third bushing which accommodates a third terminal, and wherein said second disconnection unit comprises a fifth fixed contact which is connected to said third terminal, a second moving contact, a third moving contact and a fourth moving contact which are fixed to the second operating element, the third, fourth and fifth fixed contacts being arranged respectively on the rotation plane of the second, third and fourth moving contacts, said moving contacts being fixed to the operating element in a mutual angular arrangement by virtue of which the third moving contact cannot be coupled to the fourth fixed contact when the second and/or fourth moving contacts are coupled to the corresponding fixed contacts.

25. The switchgear device according to claim 23, wherein at least one of the moving contacts that belong to the second disconnection unit is constituted by a blade which is keyed on the second operating element and is substantially perpendicular to the rotation axis of said second operating element.

26. The switchgear device according to claim 20, wherein the interruption unit comprises an interruption chamber which accommodates a fixed contact and a moving contact, the longitudinal axis of said chamber being substantially aligned with the rotation axis of the second operating element.

27. The switchgear device according to claim 26, wherein the enclosure of said interruption chamber constitutes the second operating element.

28. The switchgear device according to claim 20, wherein the rotary operating element of the first and/or the second disconnection units is actuated by an electric rotary servomotor.

## BACKGROUND OF THE INVENTION

The present invention relates to a gas-insulated switchgear device for high- and medium-voltage applications, i.e. for voltages greater than 1000 Volt, having improved functions and characteristics. In particular, the device  
5 according to the invention, by virtue of its innovative structure, allows to optimize execution of the required electric switching, according to a solution which is at the same time simple, effective and compact.

It is known from the art that electric switching operations, for both interruption and disconnection, in gas-insulated circuit breaker and disconnector units are provided by virtue of the translatory motion of one or more moving contacts which can couple/uncouple with respect to corresponding fixed contacts. A significant drawback of known types of devices is the fact that the various switching operations, for example for disconnection on the input line or on the output line, are performed by means  
10 of dedicated components which are structurally separate and mutually distinct; in this way, the number of components used to implement the various switching operations is large and entails an increase in the space occupation and total volume of the device, with a consequent cost increase.  
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Furthermore, the necessary switching operations are performed by using actuation devices which comprise actuators of the mechanical or hydraulic type which are mechanically connected to a moving contact to be moved by virtue of appropriate operating elements.  
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The actuation devices of the known art generally require complicated kinematic systems to transmit motion to the moving contact. In particular,  
25 the switching operation for disconnection requires the coordinated movement of one or more moving contacts, so that the opening/closure of the disconnection contacts occurs in the intended sequence. This usually entails complicated coupling mechanisms and/or complicated actuation and control systems, especially when disconnection occurs on multiple-bar systems.  
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In view of the mechanical complexity of the movement elements, maintenance interventions are necessary in order to maintain nominal behavior and therefore ensure repeatability of the movement, compensating for the variations caused by wear and aging of the system.

5

### SUMMARY OF THE INVENTION

The aim of the present invention is to provide a gas-insulated switchgear device in which the electrical switching operations, particularly for disconnection, occur in a simple and easily controllable way.

Within the scope of this aim, an object of the present invention is to provide a gas-insulated switchgear device which has reduced mechanical complexity and a simplified structure with respect to the devices of the known art.

Another object of the present invention is to provide a gas-insulated switchgear device in which the switching operation for disconnection occurs by using and moving a reduced number of mechanical parts.

Another object of the present invention is to provide a gas-insulated switchgear device which has reduced dimensions and space occupation.

Another object of the present invention is to provide a gas-insulated switchgear device which is highly reliable, relatively easy to provide and at competitive costs.

This aim, these objects and others which will become apparent hereinafter are achieved by a gas-insulated switchgear device, having a first bushing which accommodates a first terminal and a second bushing which accommodates a second terminal, a first enclosure which contains an interruption unit, characterized in that it comprises at least one first disconnection unit which has a first fixed contact which is electrically connected to said interruption unit and a second fixed contact at ground voltage, a first moving contact which is electrically connected to the first terminal and can be coupled to said first and second fixed contacts, said moving contact being fixed to a rotary operating element and rotating rigidly

therewith, and in that the fixed contacts that can be coupled to said first moving contact lie on the rotation plane of said moving contact.

The device according to the invention can be of the segregated-phase or joined-phase type, for a single-bar or multiple-bar system, with single-pole or three-pole actuation.

In the device according to the invention, the disconnection maneuver therefore occurs by rotation of the moving contact about a rotation axis. By virtue of the rotation, the moving contact, which in practice constitutes a rotating extension of the first terminal, couples/uncouples with respect to one of the two corresponding fixed contacts, performing the switching for disconnection and grounding of the first terminal, or maintaining electrical continuity. The moving contact can furthermore assume an intermediate position for simply disconnecting the first terminal without grounding it. For these purposes, the moving contact and the fixed contacts are arranged in such a mutual position that the ends of the fixed contacts that must engage the end of the moving contact lie on the rotation plane traced by said end of the moving contact. For the sake of simplicity, when reference is made in the present invention to the relative position of the fixed contacts and of the moving contact, reference is always intended to the relative position of the ends of the fixed contacts and of the moving contact that can be coupled thereto.

By appropriately dimensioning the position of the fixed contacts and of the moving contact it is possible to minimize the volume and the space required by the disconnection unit and therefore by the entire device, maintaining easy execution of switching for disconnection.

Another advantage of the device according to the invention is the fact that it constitutes, in practice, a prefabricated module which can be easily transported to the installation site.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages will become apparent from the

description of some preferred but not exclusive embodiments of a switchgear device according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

5 Figure 1 is a sectional view of an embodiment of a gas-insulated switchgear device for a single-bar system with single-pole actuation, according to the invention;

Figure 2 is a sectional view of an embodiment of a gas-insulated switchgear device for a two-bar system with single-pole actuation according to the invention;

10 Figure 3 is a detail view of a disconnection unit which can be used to disconnect the input line in the devices of Figures 1 and 2;

Figure 4 is a schematic view of the disconnection unit of Figure 3 during the disconnection and grounding maneuver of the input line;

15 Figures 5a-5d are schematic views of some output disconnection switching operations which can be performed with the device of Figure 2.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to Figure 1, the device according to the invention comprises an enclosure 1 which contains an interruption unit 4 and an insulating gas, a first bushing 40 which accommodates a first electrical terminal 2, and a second bushing 41 which accommodates a second electrical terminal 3; the second bushing 41 is structurally connected to the enclosure 1 by means of a flange 42.

For example, the terminals 2 and 3 can be connected to a power line in input to and output from the switchgear device, respectively; alternatively, 25 they can be connected to other electrical devices according to the applications.

In the device according to the invention, a first disconnection unit 100 is used between the input bushing 40 and the enclosure 1, at the base of the bushing 40 itself. As shown in detail in Figures 3 and 4, the disconnection unit 100 comprises an enclosure 99 which has a substantially spheroidal

central portion and two mutually opposite ends 97 and 98 which are structurally connected to the enclosure 1 and to the first bushing 40, respectively. Said disconnection unit 100 furthermore comprises a first fixed contact 96, which is electrically connected to the interruption unit 4, a second fixed contact 95 at ground voltage, which is arranged on the spherical enclosure 99, and a first moving contact 94. The moving contact 94, which is electrically connected to the input terminal 2, is fixed to a rotary operating element 93 and rotates rigidly therewith. In particular, the rotary operating element 93 is constituted by a shaft 93 which is made of insulating material and is moved by actuation elements, for example an appropriately controlled electric motor, schematically designated by the reference numeral 90 in Figure 3. Advantageously, the insulating shaft 93 has an end which is connected to the input terminal 2 and acts as structural support for said terminal 2, allowing to avoid the use of additional supporting elements.

In a preferred embodiment, and according to a solution which is structurally and functionally simple and effective, the moving contact 94 is constituted by a blade which is keyed on the insulating shaft 93 and is arranged substantially at right angles to the rotation axis of said shaft; furthermore, the moving contact 94, the first fixed contact 96 and the second fixed contact 95 are arranged so that the ends of said fixed contacts lie on the plane traced by the rotation of the end of the moving contact 94. In normal operating conditions, the moving contact 94 is coupled to the fixed contact 96 so as to determine electrical continuity between the input terminal 2 and the interruption unit 4. Switching for disconnection and grounding of the input terminal 2 occurs by turning the shaft 93; accordingly, the moving contact 94 rigidly coupled thereto couples to the fixed contact 95, thus providing the ground connection. In this manner, the switching operation is simple, with a limited number of components involved, and occurs according to an extremely compact constructive solution.

Another advantage of this solution consists of the fact that the

disconnection unit 100, being arranged inside a containment enclosure, is in a position in which it is protected against atmospheric agents, thus allowing to reduce the necessary maintenance interventions; furthermore, the substantially spheroidal shape of the enclosure 99 allows to optimize the distribution of the electric field inside said disconnection unit 100, without requiring cumbersome constructive elements.

The rotation angle of the moving contact 94 between the position in which it is coupled to the fixed contact 96 and the position in which it is coupled to the fixed contact 95 can be between 30° and 150°, preferably between 60° and 120°, more preferably between 80° and 100°; in particular, as shown in Figure 4, said rotation angle is approximately 90°. It is furthermore possible to arrange the moving contact 94 in an intermediate position in which it is coupled neither to the fixed contact 95 nor to the fixed contact 96, performing disconnection of the input terminal 2 without connecting it to the ground.

Advantageously, according to a preferred embodiment, the device according to the invention is provided with a second disconnection unit 5 which is positioned inside the enclosure 1 and is electrically connected to the interruption unit 4; as illustrated, the disconnection unit 5 is positioned on the opposite side of the interruption unit 4 with respect to the first disconnection unit 100. The second disconnection unit 5 comprises a third fixed contact 6 which is connected to the output terminal 3 and a fourth fixed contact 7 at ground voltage. In the case of Figure 1, the fixed contact 7 is connected to the enclosure 1 which is at ground voltage. The disconnection unit 5 comprises a second operating element, preferably a rotating shaft 8, which is moved by actuation elements represented schematically by the device 9, which can be for example an appropriately controlled electric motor.

A second moving contact 10, electrically connected to the interruption unit 4, is fixed to the shaft 8 and rotates rigidly with it. In the embodiment of

Figure 1, the second moving contact 10 is constituted by a blade which has a circular sector-shaped profile and is keyed on the shaft 8. The moving contact 10 and the third and fourth fixed contacts 6 and 7 are arranged so that the ends of said fixed contacts lie on the plane traced by the rotation of  
5 the end of the moving contact 10. In this case, the disconnection operation occurs by turning the shaft 8; accordingly, the moving contact 10 rigidly coupled thereto couples to the fixed contact 6 or 7, thus providing the line or ground connection of the output terminal 3, respectively. In Figure 1, the moving contact 10 is coupled to the fixed contact 7; the ground connection is  
10 therefore closed, while the output connection is open.

According to an alternative embodiment, not shown in the figure, it is possible to have two moving contacts which are fixed to the shaft 8, each being able to couple to a corresponding fixed contact. In this case, the fixed contact 6 lies on the rotation plane of one of the two moving contacts that can be coupled thereto, while the fixed contact 7 lies on the rotation plane of the other moving contact that can be coupled thereto. Furthermore, the two moving contacts are fixed to the shaft 8 in a relative angular position by virtue of which they cannot be simultaneously coupled to the fixed contacts 6 and 7. In this manner, by virtue of the rotation of the shaft 8, one obtains  
15 for example uncoupling between the fixed contact 6 and the first moving contact, followed by coupling between the fixed contact 7 and the second moving contact, thus providing ground disconnection. It is possible to proceed in the same manner when one wishes to open the ground disconnection contact and close the line contact.  
20

A gas-insulated switchgear device for a two-bar system is now described  
25 with reference to Figure 2. As previously described, the device of Figure 2 comprises an enclosure 1 which contains a disconnection unit 5 and an interruption unit 4, and contains an insulating gas, a first bushing 40 which accommodates an input terminal 2, and a second bushing 41 which accommodates a first output terminal 11. Between the bushing 40 and the  
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enclosure 1 there is a disconnection unit 100; the device furthermore comprises a third bushing 43 which accommodates a second output terminal 13. In this case, the disconnection unit 5 comprises a third fixed contact 21 which is connected to the output terminal 11, a fourth fixed contact 22 at ground voltage, and a fifth fixed contact 23 which is connected to the second output terminal 13. As in Figure 1, the fixed contact 22 is connected to the enclosure 1 which is at ground voltage. The disconnection unit 5 comprises a rotating shaft 8 which is moved by actuation elements which are schematically represented by the device 9, which can be for example an appropriately controlled electric motor.

A second moving contact 31, a third moving contact 32 and a fourth moving contact 33, electrically connected to the interruption unit 4, are fixed to the shaft 8 and rotate rigidly therewith. In the embodiment of Figure 2, the moving contacts 31, 32 and 33 are constituted by blades which have a circular sector-like profile and are keyed to the shaft 8. The moving contacts 31, 32, 33 and the fixed contacts 21, 22, 23 are arranged so that for each pair of contacts (21, 31), (22, 32) and (23, 33) the fixed contact lies on the rotation plane of the corresponding moving contact. Furthermore, the moving contacts 31, 32 and 33 are fixed to the shaft 8 with such an angular arrangement that the moving contact 32 cannot be coupled to the fixed contact 22 when the moving contact 31 and/or the moving contact 33 are coupled to the corresponding fixed contacts 21 and 23. Switching for disconnection on the output terminal side occurs by turning the shaft 8; accordingly, the moving contacts 31, 32 and 33 rigidly coupled thereto couple to the respective fixed contacts 21, 22 and 23. In Figure 2, the moving contact 32 is coupled to the fixed contact 22, while the moving contacts 31 and 33 are uncoupled from the respective fixed contacts 21 and 23; the ground connection is therefore closed, while the output connections are open.

The operating principle is shown schematically in Figures 5a-5d, in which

the moving contacts are constituted by blades which are keyed to the shaft 8.

With reference to Figure 5a, a situation is shown in which the moving contact 32 is coupled to the corresponding fixed contact 22, while the moving contacts 31 and 33 are uncoupled from the corresponding fixed contacts. By turning the shaft 8 in the direction of the arrow, the ground contact is opened and then the moving contact 31 couples to the fixed contact 21, closing the connection toward the output terminal 11 (Figure 5b). By again turning the shaft 8 in the same direction, the moving contact 33 couples to the fixed contact 33 before uncoupling occurs between the contacts 21 and 31. In this manner, the connection toward the output terminal 13 is closed while the connection toward the terminal 11 simultaneously remains closed (Figure 5c). If the rotation of the shaft 8 is continued, it is possible to separate the contact 31 from the contact 21, opening the connection toward the terminal 11 and keeping closed the connection toward the terminal 13 (Figure 5d). It is furthermore possible to perform a switching operation, not shown, in which all the moving contacts are uncoupled from the corresponding fixed contacts so that the output terminals are disconnected without being grounded.

According to an alternative embodiment, not shown, the second disconnection unit 5 comprises just two moving contacts which are fixed to the shaft 8. The fixed ground contact 22 and one of the other two fixed contacts, for example the fixed contact 21, lie on the rotation plane of said moving contact, which can be coupled alternately to the fixed contact 21 or to the fixed contact 22; the third fixed contact 23 lies on the rotation plane of the other moving contact and can be coupled thereto. The two moving contacts are fixed to the shaft 8 with a mutual angular arrangement by virtue of which they cannot be simultaneously coupled to the contacts 22 and 23, while their relative angular position is such that they can be simultaneously coupled to the fixed contacts 21 and 23.

As previously indicated, in both embodiments of Figures 1 and 2, the

switchgear device according to the invention comprises an interruption unit 4 which has an interruption chamber which accommodates a fixed contact 14 and a moving contact 15, the longitudinal axis of the interruption chamber being substantially aligned with the rotation axis of the second operating element 8. In this case, the opening/closure switching of the interruption unit 4 is performed by means of a translatory motion of the moving contact of the interruption unit along the longitudinal axis of the device, while disconnection on the output terminal side occurs by rotation of the moving contacts of the disconnection unit 5 about said longitudinal axis.

According to a particular embodiment, not shown, the operating element of the disconnection unit 5 is constituted by the enclosure 80 of the interruption chamber. In this case, the moving contacts of the second disconnection unit 5 are keyed to the outer surface of the interruption chamber, which can rotate with respect to the enclosure 1 of the device. The movement is applied by actuation elements, for example an appropriately controlled electric motor. The mutual arrangement of the fixed contacts and of the moving contacts is similar to the one shown in Figures 1 or 2, depending on whether a single- or two-bar system is provided. By using this technical solution, the device according to the invention is particularly compact, since the space occupied by the disconnection unit 5 is distributed inside the enclosure 1 along the interruption chamber.

As mentioned, the disconnection elements are moved by virtue of suitable actuation means, preferably constituted by a controlled electric motor. In particular, it has been found that the use of a servomotor, both for the first disconnection unit 100 and for the second disconnection unit 5, as well as for the movement of the moving contacts of the interruption unit 4, allows considerable advantages in terms of switching precision and speed. Alternatively, it is possible to use mechanical or hydraulic actuation means. Manual actuation means can also be provided alternatively, or in addition, to the above described actuation means, particularly to perform emergency

manual switching.

The device according to the invention can be of the type with single-pole actuation, in which actuation means are provided on each individual phase in order to perform switching for disconnection; alternatively, it can be of the type with three-pole actuation, in which the energy for switching for disconnection on the three phases of the device is provided by a single actuation means which is mechanically coupled to the disconnection units of each individual phase.

The gas-insulated switchgear device thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may furthermore be replaced with technically equivalent elements. In practice, the configurations considered, so long as they are compatible with the specific use, as well as the individual components, may be any according to the requirements and the state of the art.

## CLAIMS

1. A gas-insulated switchgear device, having:
  - a first bushing (40) which accommodates a first terminal (2) and a second bushing (41) which accommodates a second terminal (3);
  - a first enclosure (1) which contains an interruption unit (4); and
  - at least one first disconnection unit (100) which has a first fixed contact (96) which is electrically connected to said interruption unit (4), and a second fixed contact (95) at ground voltage, and a first moving contact (94) which is electrically connected to the first terminal (2) and can be coupled to said first and second fixed contacts (96, 95), said first moving contact (94) being fixed to a rotary operating element (93) and rotating rigidly therewith, the first and second fixed contacts (96, 95) lying on the rotation plane of said first moving contact (94), characterized in that said rotary operating element (93) comprises a shaft made of insulating material, said shaft having an end which is connected to the first terminal (2) and being suitable to support it structurally.
2. The switchgear device according to claim 1, characterized in that said first disconnection unit (100) comprises an enclosure (99) which has a substantially spheroidal central portion and two mutually opposite ends (97, 98) which are structurally connected respectively to said first enclosure (1) and to said first bushing (40).
3. The switchgear device according to claim 2, characterized in that said second fixed contact (95) at ground voltage is arranged on the spheroidal portion.
4. The switchgear device according to claim 1, characterized in that the first moving contact (94) is constituted by a blade which is keyed on said operating element (93) and is substantially perpendicular to its rotation axis.
5. The switchgear device according to one or more of the preceding claims, characterized in that said first moving contact (94) can be turned between a

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first position for coupling to the first fixed contact (96) and a second position for coupling to the second fixed contact (95), the rotation angle between the first position and the second position being between 30° and 150°, preferably between 60° and 120°, more preferably between 80° and 100°.

5     6. The switchgear device according to claim 1, characterized in that it comprises a second disconnection unit (5) which is arranged inside said first enclosure (1) and comprises a third fixed contact (6, 21) which is connected to the second terminal (3) and a fourth fixed contact (7, 22) which is at ground voltage, at least one second moving contact (10) which can be coupled to at least one of said third and fourth fixed contacts (6, 7, 21, 22) and is electrically connected to said interruption unit (4), said second moving contact (10) being fixed to a second rotary operating element (8) and rotating rigidly therewith, the fixed contact (6, 7, 21, 22) that can be coupled to said second moving contact (10) being arranged on the rotation plane of said second moving contact (10).

10    7. The switchgear device according to claim 6, characterized in that said second disconnection unit (5) comprises a single moving contact (10) and in that said third and fourth fixed contacts (6, 7) lie on the rotation plane of the moving contact (10).

15    8. The switchgear device according to claim 6, characterized in that said second disconnection unit (5) comprises a second moving contact (10) and a third moving contact which are fixed to said second operating element (8), and in that said third and fourth fixed contacts (6, 7) lie respectively on the rotation plane of said second and third moving contacts, which are fixed to said second operating element (8) in a relative angular arrangement by virtue of which they cannot be simultaneously coupled respectively to said third and fourth fixed contacts (6, 7).

20    25    9. The switchgear device according to one or more of claims 6-8, characterized in that it comprises a third bushing (43) which accommodates a third

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terminal (13) and in that said second disconnection unit (5) comprises a fifth fixed contact (23) which is connected to said third terminal (13), a second moving contact (31) and a third moving contact (32) which are fixed to the second operating element (8), said third and fourth fixed contacts (21, 22) being arranged on the rotation plane of said second moving contact (31), the fifth fixed contact (23) being arranged on the rotation plane of said third moving contact (32), the second and third moving contacts (31, 32) being fixed to the second operating element (8) in a mutual angular arrangement by virtue of which they cannot be simultaneously coupled respectively to said fourth and fifth fixed contacts (22, 23).

10. The switchgear device according to one or more of claims 1 to 8, characterized in that it comprises a third bushing (43) which accommodates a third terminal (13), and in that said second disconnection unit (5) comprises a fifth fixed contact (23) which is connected to said third terminal (13), a second moving contact (31), a third moving contact (32) and a fourth moving contact (33) which are fixed to the second operating element (8), the third, fourth and fifth fixed contacts (21, 22, 23) being arranged respectively on the rotation plane of the second, third and fourth moving contacts (31, 32, 33), said moving contacts (31, 32, 33) being fixed to the operating element (8) in a mutual angular arrangement by virtue of which the third moving contact (32) cannot be coupled to the fourth fixed contact (22) when the second and/or fourth moving contacts (31, 33) are coupled to the corresponding fixed contacts (21, 23).

20. The switchgear device according to one or more of claims 7 to 10, characterized in that at least one of the moving contacts (31, 32, 33) that belong to the second disconnection unit (5) is constituted by a blade which is keyed on the second operating element (8) and is substantially perpendicular to the rotation axis of said second operating element (8).

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12. The switchgear device according to one or more of the preceding claims,  
characterized in that the interruption unit (4) comprises an interruption  
chamber which accommodates a fixed contact (14) and a moving contact  
(15), the longitudinal axis of said chamber being substantially aligned with  
the rotation axis of the second operating element (8).

5

13. The switchgear device according to claim 12, characterized in that the  
enclosure of said interruption chamber constitutes the second operating  
element.

10

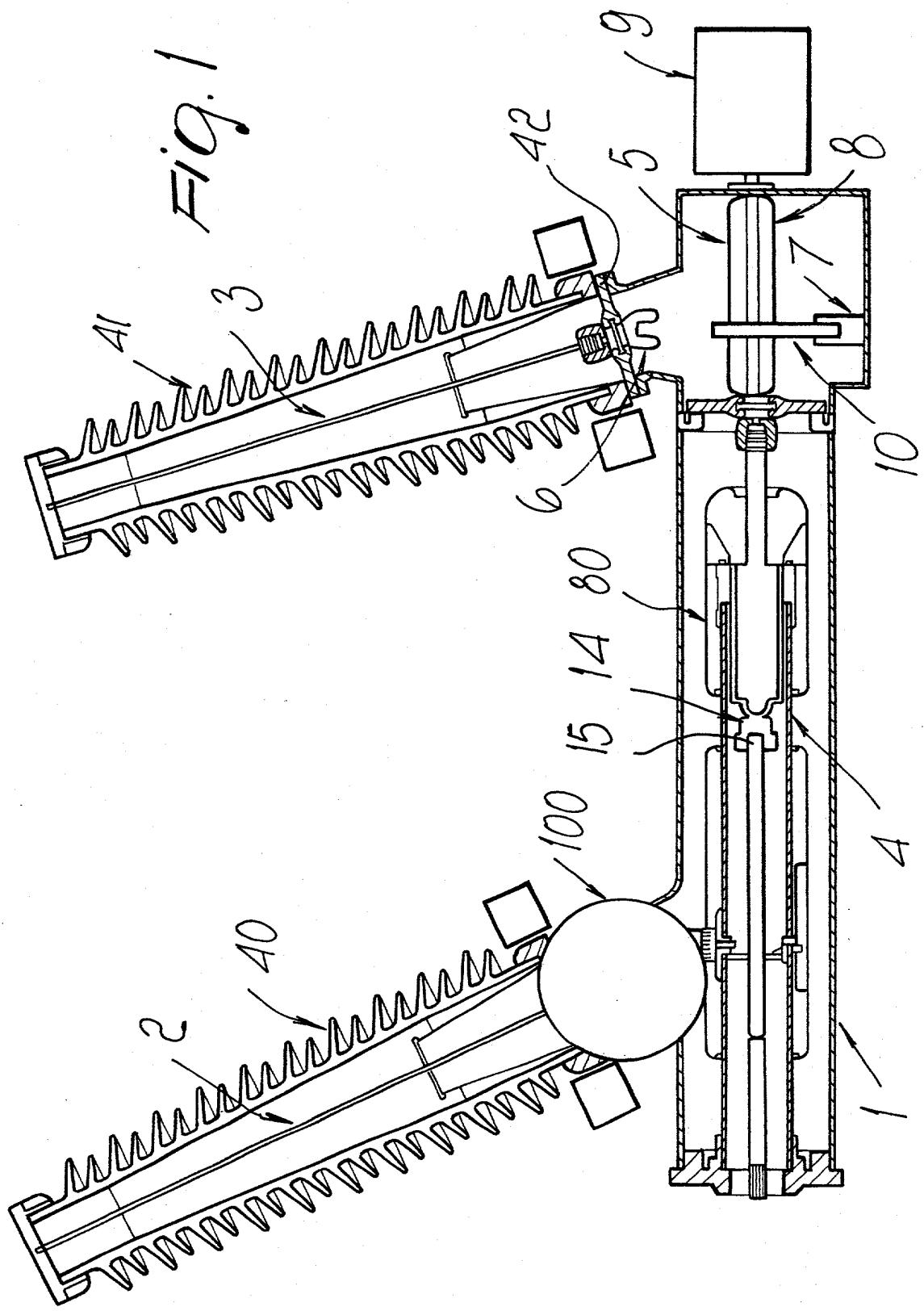
14. The switchgear device according to one or more of the preceding claims,  
characterized in that the rotary operating element (93, 8) of the first and/or  
the second disconnection units (100, 5) are actuated by an electric rotary  
servomotor.

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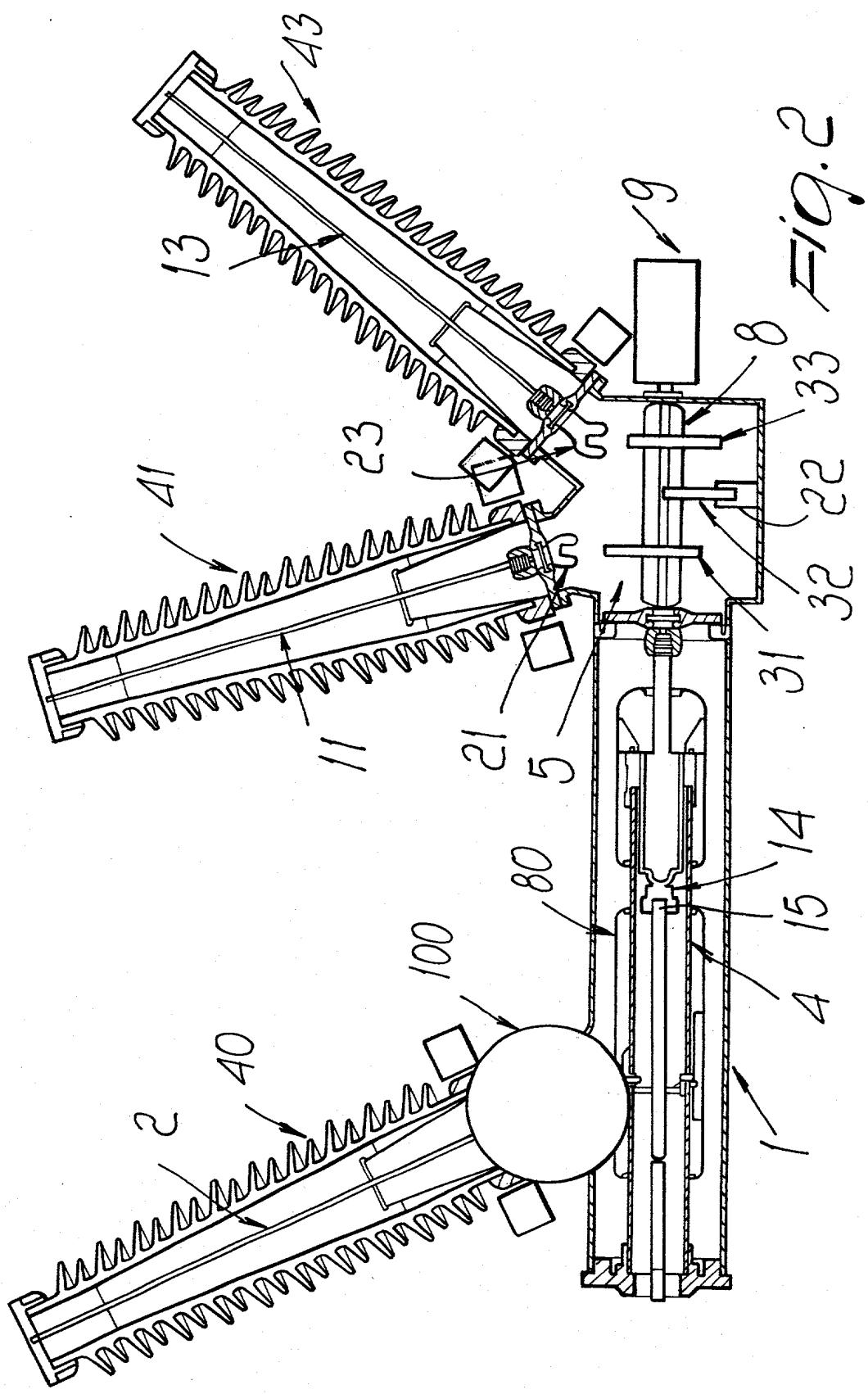
## ABSTRACT

A gas-insulated switchgear device which has a first bushing which accommodates a first terminal, a second bushing which accommodates a second terminal, a first enclosure which contains an interruption unit, and at least one first disconnection unit which has a first fixed contact electrically connected to the interruption unit and a second fixed contact at ground voltage, a first moving contact which is electrically connected to the first terminal and can be coupled to the first and second fixed contacts, the moving contact being fixed to a rotary operating element and rotating rigidly therewith, the fixed contacts that can be coupled to the moving contact lying on the rotation plane of the moving contact.

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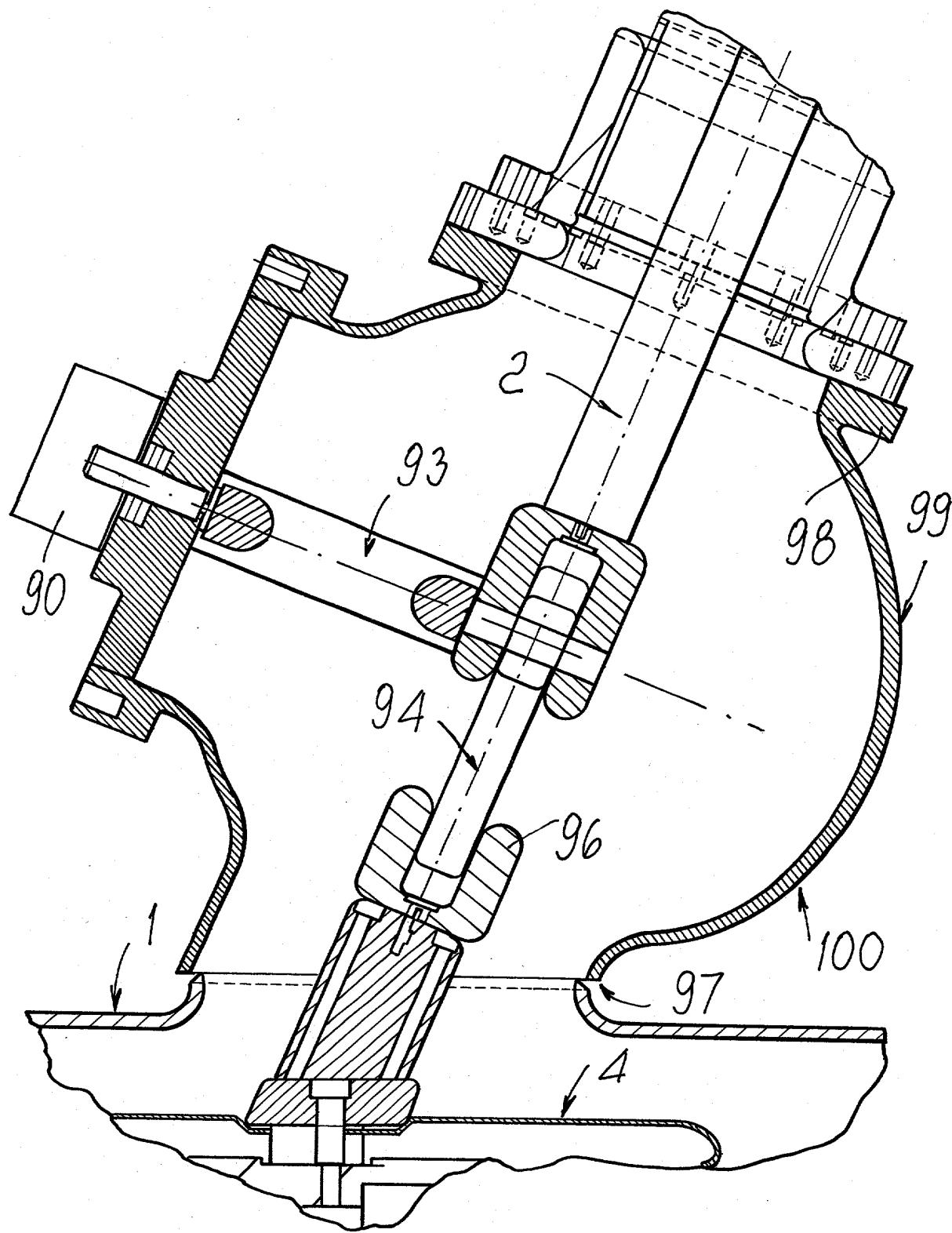


FIG. 3

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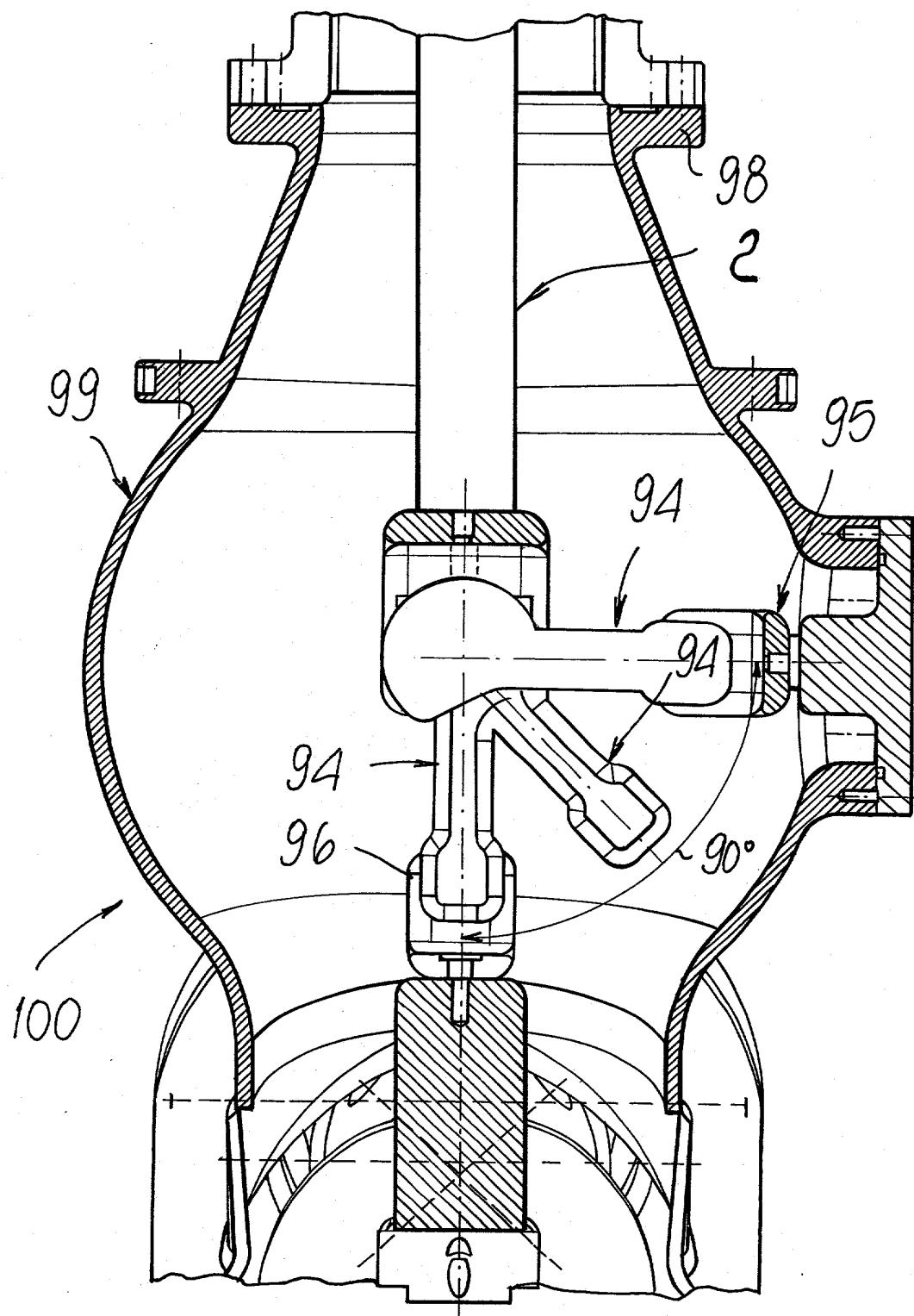


Fig. 4

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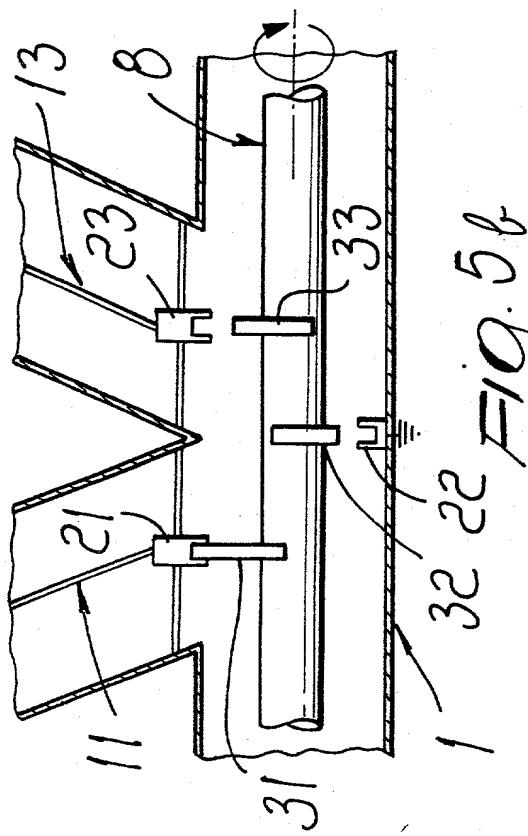


Fig. 5b

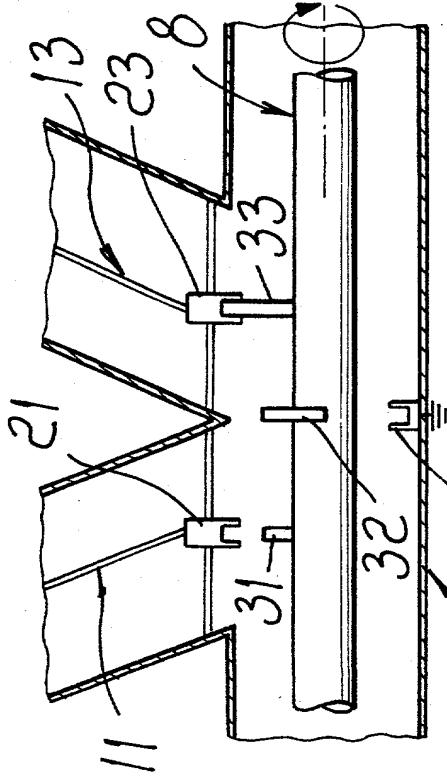


Fig. 5d

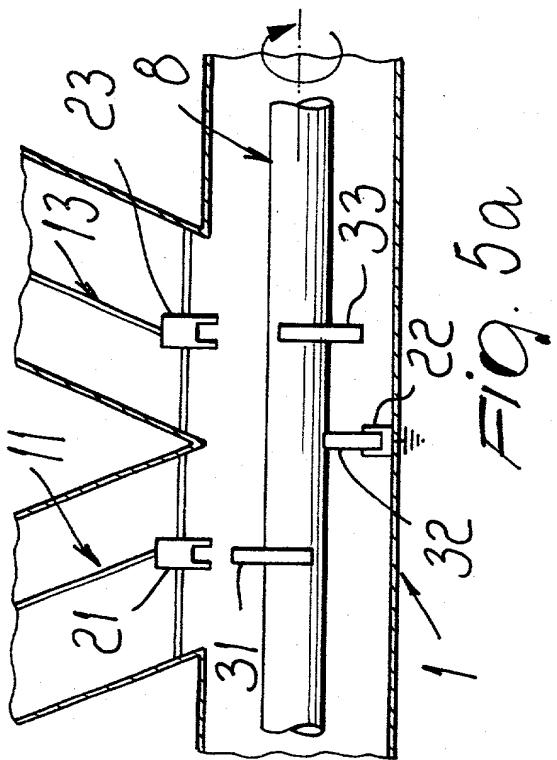


Fig. 5a

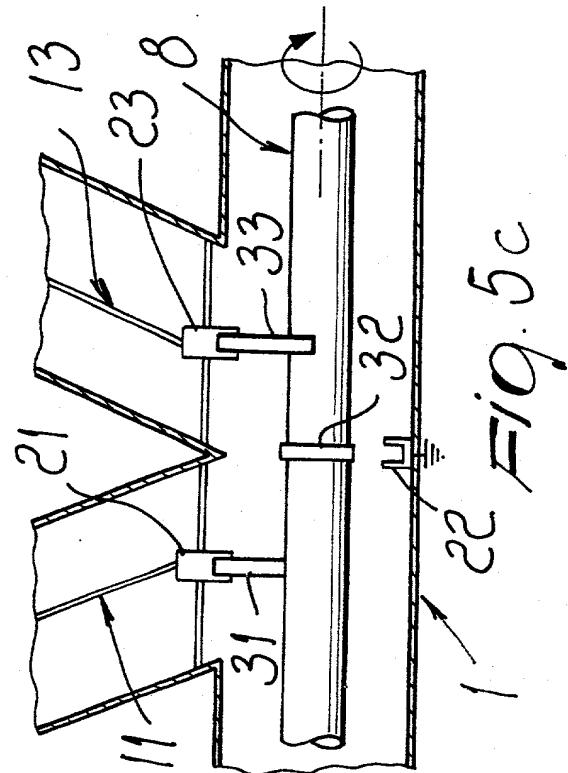


Fig. 5c

**PATENT**

Attorney's Docket No. 35845/GM/1p

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**COMBINED DECLARATION AND POWER OF ATTORNEY**

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**(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL,  
CONTINUATION OR CIP)**

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As a below named inventor, I hereby declare that:

**TYPE OF DECLARATION**

This declaration is of the following type: (check one applicable item below)

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**NOTE:** If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application do not check any of next two items and check appropriate one of last three items.

national stage of PCT

supplemental

**NOTE:** If one of the following 3 items apply then complete and also attach ADDED PAGES FOR DIVISIONAL  
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divisional

continuation

continuation-in-part (CIP)

**INVENTORSHIP IDENTIFICATION**

**WARNING:** If the inventors are each not the inventors of all the claims an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

---

**TITLE OF INVENTION**  
**GAS-INSULATED SWITCHGEAR DEVICE**

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**SPECIFICATION IDENTIFICATION**

the specification of which: (complete (a), (b) or (c))

(a)  is attached hereto.

(b)  was filed on \_\_\_\_\_ as  Serial No. \_\_\_\_\_  
or  Express Mail No., as Serial No. not yet known \_\_\_\_\_  
and was amended on \_\_\_\_\_ (if applicable).

**NOTE:** Amendments filed after the original papers are deposited with the PTO which contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.57.

(Declaration and Power of Attorney [1-1]—page 1 of 1)

(c)  was described and claimed in PCT International Application No. PCT/EP00/08842 filed on September 4, 2000 and as amended under PCT Article 19 on \_\_\_\_\_ (if any).

#### ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations. § 1.56(a).

In compliance with this duty there is attached an information disclosure statement 37 CFR 1.97.

#### PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

(d)  no such applications have been filed.

(e)  such applications have been filed as follows

NOTE: Where item (c) is entered above and the International Application which designated the U.S. claimed priority check item (e), enter the details below and make the priority claim.

#### EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

COUNTRY	APPLICATION NUMBER	DATE OF FILING (month, day, year)	PRIORITY CLAIMED UNDER 37 USC 119
ITALY	MI99A001923	15 SEPTEMBER 1999	<input checked="" type="checkbox"/> YES NO <input type="checkbox"/>
WIPO	PCT/EP00/08842	04 SEPTEMBER 2000	<input checked="" type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>

#### ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

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# POWER OF ATTORNEY

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration number)

Guido MODIANO (Reg. No. 19,928)

(3) Albert JOSIF (Reg. No. 22,917)

Daniel J. O'BYRNE (Reg. No. 36,625)

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(02) 86.92.442

## DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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ceased or incapacitated inventor. Number of pages added \_\_\_\_\_

Signature for inventor who refuses to sign or cannot be reached by person au-  
thorized under 37 CFR 1.47. Number of pages added \_\_\_\_\_

• • •

Added pages to combined declaration and power of attorney for divisional, con-  
tinuation, or continuation-in-part (CIP) application.

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